NerdCam3D Mk.2 Instruction Manual

IMPORTANT – READ CAREFULLY BEFORE USE
KEEP FOR FUTURE REFERENCE

EN

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List of Abbreviations

BEC	Battery Eliminator Circuit
ESD	Electrostatic Discharge
FS	Field-Sequential
CVBS	Color Video Blanking Signal
FPV	First Person View
MSP	MultiWii Serial Protocol
OSD	On-Screen Display
SBS	Side-by-Side
SELV	Separated/Safety Extra Low Voltage

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NC3DMk2 Manual EN V1.0

1 Quick Start Guide

The NerdCam3D Mk.2 is a stereoscopic FPV flight camera. The factory settings of the camera are:

- Video norm: PAL,
- 3D-Mode: Squeezed Side-by-Side 3D,
- Image swap: No swap,
- Auto-exposure measurement window: Full window,
- Stopwatch: Automatic start after power-up.

These settings provide compatibility with most of the currently available 3D-capable FPV goggles like Dominator HD, Dominator HD V2, Cinemizer, Cinemizer Plus, Cinemizer OLED, or Dominator V3. Users of Attitude V3 or Headplay video goggles (without Side-by-Side 3D support) – refer to chapter 2 for Field-Sequential 3D video setup.

1	Connect the camera's video output (the terminal bock on the back side labeled with **GND** and **3D**) to your video transmitter. If possible, use a separate ground wire between camera and video transmitter.
2	Connect the camera to a clean **5V DC power supply** using the terminal block on the back side labeled with **GND** and **+5V**. If your RC-platform does not have a 5V power rail, use a 5V-BEC which is able to source at least 1 A. **Don't power the camera directly from of a flight battery.**
3	Power-up the camera and check whether the green status LED is continuously on. Check the received video signal with your FPV goggle. Typically such goggles need to be put into 3D mode manually. See the manual of your FPV goggle if unsure how to put the goggle into 3D-mode.
4	**Only For Dominator V3 video goggle:** This device has an acknowledged design glitch when put into 3D-AV mode[1]. The NerdCam3D Mk. 2 is able to compensate this glitch completely and without any trade-off. Refer to chapter 4.4 for details.
5	Some FPV goggles occasionally swap the left/right images. Use the swap feature of the camera for instant compensation. Some video goggles (in particular those with support for field-sequential 3D only) have an own image swap feature.

Enjoy your first flight with the NerdCam3D Mk.2 and become familiar with FPV in three dimensions. See the other chapters of this manual for information on how to activate the 3D-OSD and how to use the adjustment features of the camera.

1 http://www.rcgroups.com/forums/showpost.php?p=33184001&postcount=1850

2 Overview

The camera has five different control elements on the front side: push buttons #1 to #4 and a DIP switch. The DIP switch configures the fundamental operation parameters, whereas the push buttons are used for adjustment purposes (see chapter 4 for details). The green status LED indicates the current state of operation.

2.1 Control Elements

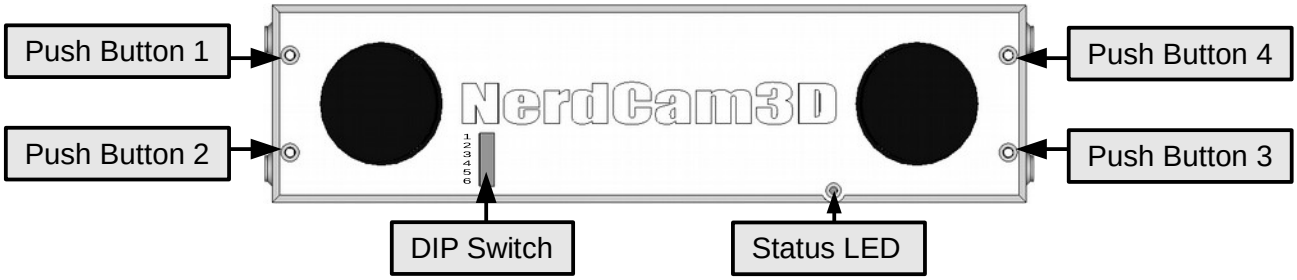

Figure 1: Control elements on front side

Status LED	
State	**Remark**
Off	No power supply. Camera out of operation.
On	Normal operation.
Blinking	Camera in adjustment mode (see chapter 4).

DIP Switch				
Number	**Function**	**Position left**	**Position right**	**Changes apply**
1 (top)	Video norm	PAL	NTSC	After power cycle
2	3D mode	Side-by-side (SBS)	Field-sequential (FS)	Instantly
3	Image swap	Left/right not swapped	Left/right swapped	Instantly
4	SBS-mode	squeezed	cropped	Instantly
5	Exposure Window	Full window	Lower half window	After power cycle
6 (bottom)	OSD stop watch	Runs automatically after power-up	Runs after amperage reaches 3A for first time[2]	After power cycle

2 Requires working current sensor, e.g. NerdSense Mk.1 sensor board or separate current sensor, connected to flight controller.

2.2 Terminals

The camera is connected to power supply and other equipment using the ports on the back side (see Figure 2).

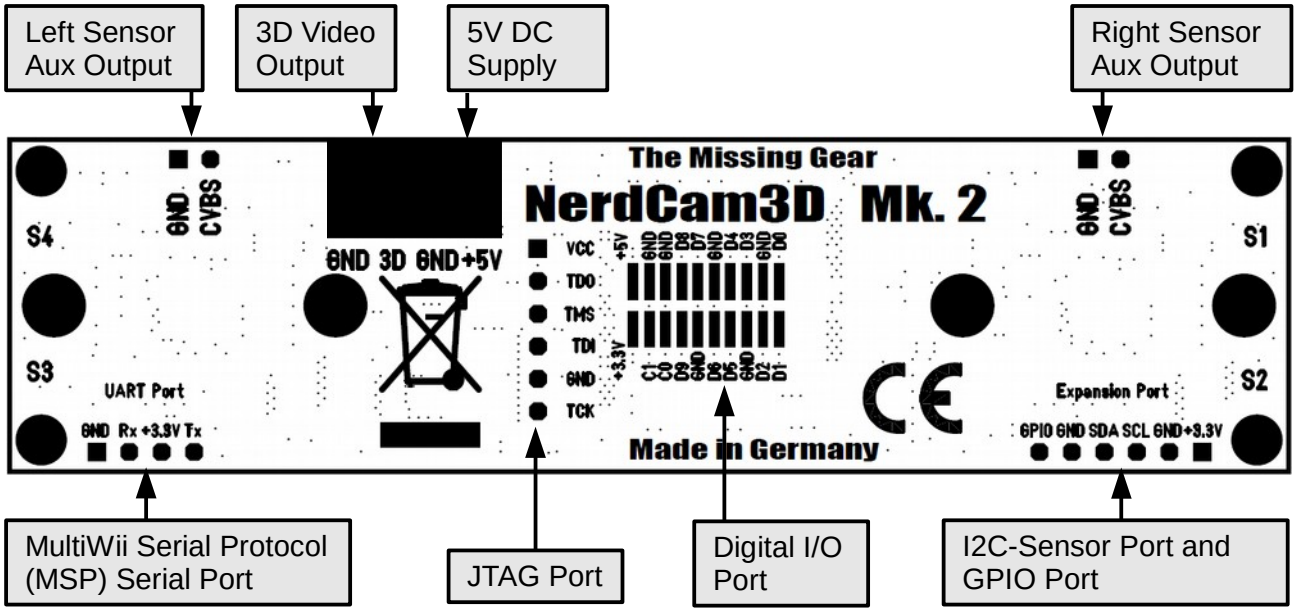

Figure 2: Ports on back side

NOTICE	**Risk of electrostatic discharge!**
	Take appropriate measures to protect the camera against electrostatic discharge during assembly, technical modification and operation.

Connector *5V DC Supply*		
Pin	**Signal**	**Remark**
GND	Ground	
+5V	+5V DC supply voltage	Use LC-power filters if necessary. +/- 5% voltage tolerance is acceptable. Use a 5V-BEC if no 5V power rail is available on your system.
⚠ WARNING		**Risk of electric shock!**
		Operate camera with Separated/Safety Extra Low Voltage (SELV) power sources only!
⚠ WARNING		**Risk of fire! Burn hazard!**
		Operate the camera at the specified power supply voltage of +5V (+/- 5%) only!

Connector *3D Video Output*		
Pin	**Signal**	**Remark**
GND	Ground	
3D	Composite video signal	Filtered DC-coupled analog video (CVBS) output.

Connectors *Left Sensor Aux Output* & *Right Sensor Aux Output*		
Pin	**Signal**	**Remark**
GND	Ground	
CVBS	Composite video signal	Filtered DC-coupled analog video (CVBS) output. Notice: These ports do not support the 3D-OSD feature of the camera.

Connector *MultiWii Serial Protocol Port*		
Pin	**Signal**	**Remark**
GND	Ground	
Rx	Serial receiver	Expects 115200 Bd symbol rate. 5V logic level tolerant input.
+3.3V	Auxiliary 3.3V supply	Connected to internal 3.3V supply rail.
Tx	Serial transmitter	Transmits at 115200 Bd symbol rate. 3.3V logic level output.
Connect the signals of this port with the corresponding signals at your flight controller's serial port: Rx (camera) ↔Tx (flight controller) Tx (camera) ↔ Rx (flight controller) GND (camera) ↔ GND (flight controller) The camera automatically enables the 3D-OSD when a compatible flight controller is detected. This is a hot-plug feature.		

Connector *I2C-Sensor Port and GPIO Port*		
Pin	**Signal**	**Remark**
GPIO	In/out port	Currently unused.
GND	Ground	
SDA	Serial data	Connect to *NerdSense Mk.1* sensor SDA pin.
SCL	Serial clock	Connect to *NerdSense Mk.1* sensor SCL pin.
GND	Ground	Connect to *NerdSense Mk.1* sensor GND pin.
+3.3V	Auxiliary 3.3V supply	Connect to *NerdSense Mk.1* sensor +3.3V pin.
Connect the signals of this port to the *NerdSense Mk.1* sensor board (available separately, see details at http://www.themissinggear.eu/nerdsense-mk-1/) in case the MSP port feature cannot be used. Both NerdSense Mk.1 and the MSP port features cannot operate at the same time.		

3 Integrated On-Screen Display

The camera features an integrated On-Screen Display (OSD) which is generated inside the camera's digital video processing unit (Figure 3).

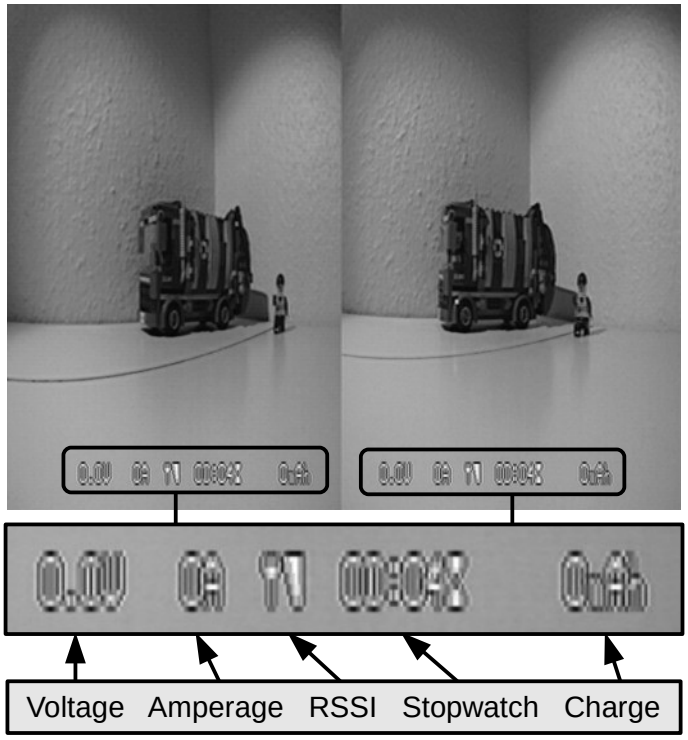

Figure 3: Stereoscopic OSD in side-by-side mode

The OSD is activated automatically if either a NerdSense Mk.1 current sensor is detected or if a MultiWii Serial Protocol (MSP) response is present at the MSP serial port of the camera. At present the integrated OSD features the display elements shown in Figure 3. Future versions of the camera firmware may include more elements, e.g. global navigation satellite system (GNSS) support.

The OSD is available for all 3D-modes of operation (Side-by-Side / Field-Sequential 3D, cropped and squeezed Side-by-Side 3D). In addition, the OSD is used to support and to simplify the configuration / adjustment of the camera.

4 Adjustment Modes

The camera features a number of adjustment modes in order to improve the user experience. All adjustments are made using the four push buttons on the front side of the camera. The result of these adjustments is instantly applied and saved into a nonvolatile memory section of the camera's video processing unit for future use. All adjustment steps are assisted with OSD, even if there is no NerdSense current sensor or MSP signal present at the respective camera ports.

4.1 Vertical Sensor Adjustment

Manufacturing tolerances sometimes lead to vertically misaligned left and right images. This effect is most prominent in side-by-side mode (Figure 4). The camera is able to compensate such misalignment without loss of resolution or black bar padding.

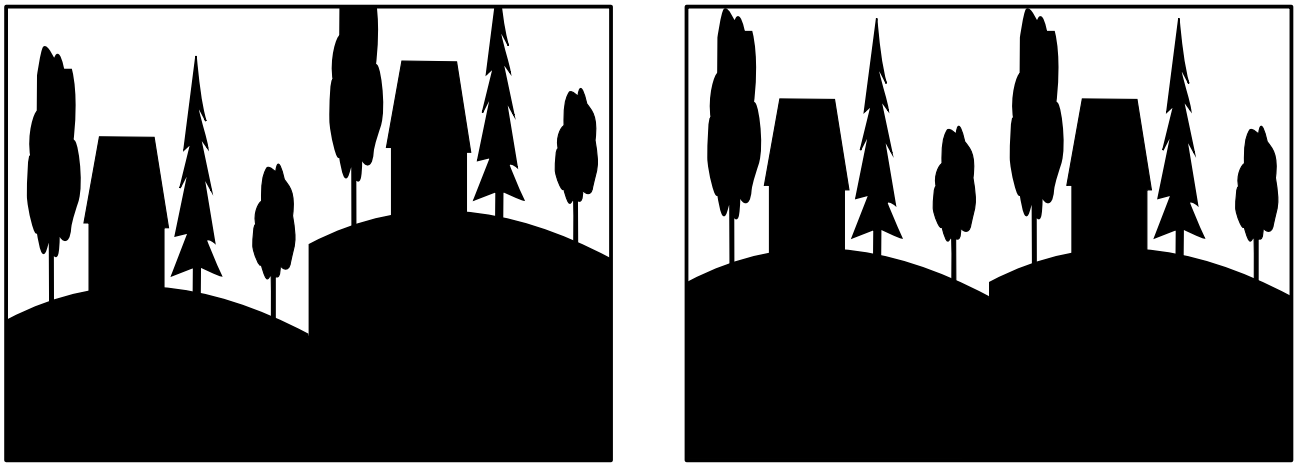

Figure 4: Vertically misaligned images (left) and correctly aligned images (right)

The respective functions of the push buttons for this type of adjustment are shown in the next figure. Press and hold push button **S1** for about 1.5 seconds until the status LED starts to blink. Use buttons **S3** and **S4** to adjust the vertical offset until left and right image are correctly aligned. Press and release push button **S1** again to save and exit or press push button **S2** to cancel. Due to technical constraints of the image sensors the video output flashes upon each press action on S3 and S4. This is simply due to image sensor reconfiguration and has no impact on the normal use of the camera.

Figure 5: Push button functions for vertical sensor adjustment

4.2 3D-OSD Convergence Adjustment

The camera has a default setting for the virtual position, in which the 3D-OSD floats in front of the main scene. This setting can be changed, in order to virtually move the OSD away or to bring it closer. This setting applies to all 3D-modes of the camera.

The respective functions of the push buttons for this type of adjustment are shown in the next figure. Press and hold push button **S2** for about 1.5 seconds until the status LED starts to blink.

Use buttons **S3** and **S4** to adjust the virtual OSD distance. Press and release push button **S2** again to save and exit or press push button **S1** to cancel.

Figure 6: Push button functions for 3D-OSD convergence adjustment

4.3 Cropped Side-by-Side Offset Adjustment

The camera includes a useful special feature for the cropped Side-by-Side 3D mode in which the actual cropped region on left and right image is virtually panned. This panning reduces or increases the resulting interaxial distance between the center points of both left and right picture (Figure 7). This feature is included for better support of all Google Cardboard alike goggles[3]. The default position of the cropped area is in the middle of both left and right image.

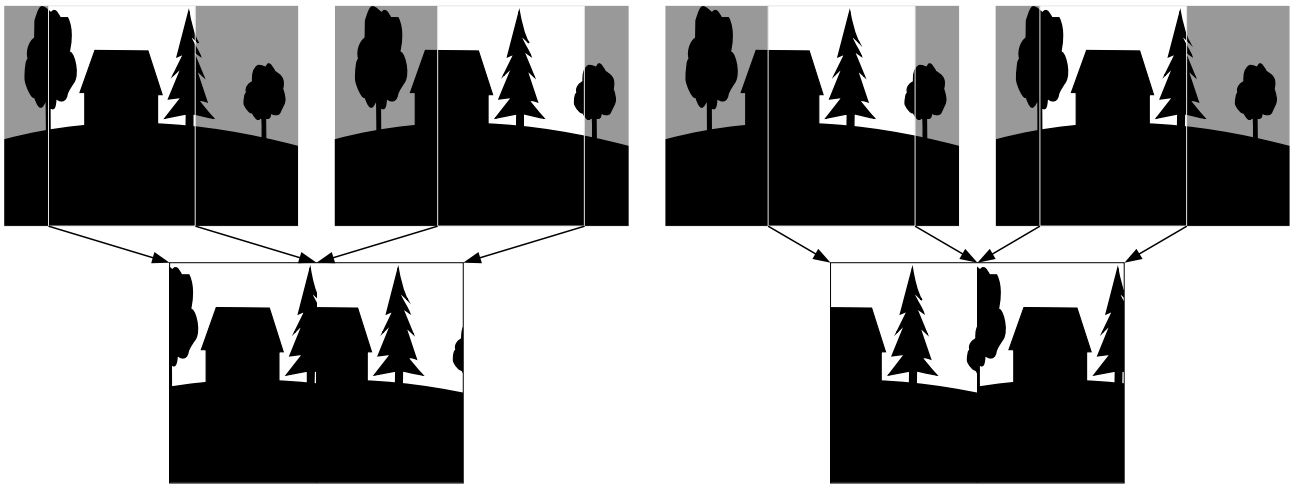

Figure 7: Outward panning (left) and inward panning (right)

The respective functions of the push buttons for this type of adjustment are shown in the next figure. Press and hold push button **S3** for about 1.5 seconds until the status LED starts to blink. Use buttons **S1** and **S2** to adjust the position of the cropped area. Both cropped areas are either moving inwards or outwards as depicted in Figure 7. Press and release push button **S3** again to save and exit or press push button **S4** to cancel.

3 https://www.google.com/get/cardboard/

Figure 8: Push button functions for cropped side-by-side offset adjustment

4.4 Squeezed Side-by-Side Offset Adjustment

This last adjustment mode is only necessary for video goggles that do not separate the left and right picture from the squeezed side-by-side input video correctly in the middle of the video frame. A typical symptom is the visibility of portions of the right hand side image in the left display of the goggle or vice versa. This effect can be compensated with the camera by slightly shifting the whole side-by-side raw video arrangement to the left or to the right, without compressing or stretching the raw side-by-side video (Figure 9).

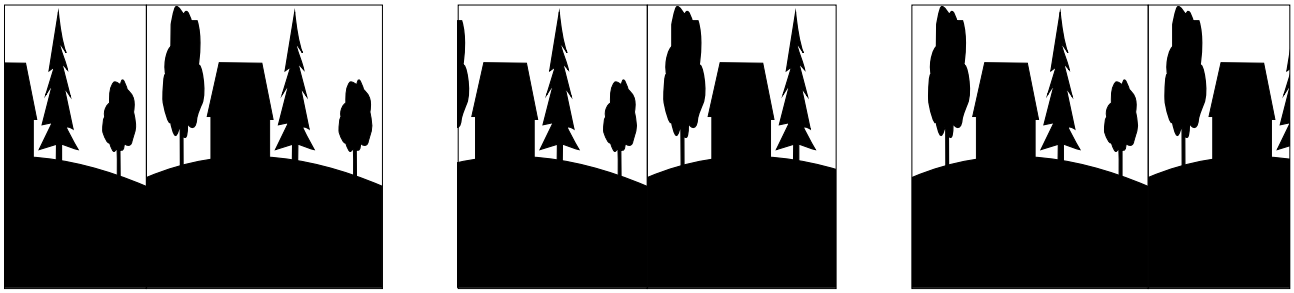

Figure 9: Squeezed SBS offset positions: to the left, center, to the right

The respective functions of the push buttons for this type of adjustment are shown in the next figure. Press and hold push button **S4** for about 1.5 seconds until the status LED starts to blink. Use buttons **S1** and **S2** to adjust the desired amount of shift. Press and release push button **S4** again to save and exit or press push button **S3** to cancel.

Figure 10: Push button functions for squeezed side-by-side offset adjustment

5 Error Indication and Troubleshooting

This section summarizes symptoms of wrong operation conditions and their typical impact on the performance of the camera.

Symptom	Comments / Suggestions
LED permanently off, no video signal	Supply voltage too low or absent.
LED stays off, no video signal or distorted/flickering video signal, however power supply voltage present	Check BEC, exchange BEC and install LC filters optionally. Some BEC operate near or at a multiple of the camera's clock frequency (27MHz) and consequently cause strong interference, which the internal camera power filter cannot eliminate. **In case the camera works with a conventional battery pack (e.g. 4x1.2V NiMH batteries) but not with the present BEC then the BEC needs to be exchanged. Contact support for suggestions.**
Transient interference within the video signal, which do not originate from the utilized wireless video transmission gear	Missing ground connection between the video output of the camera and video input of the transmitter. The video signal is an RF signal and (ideally) should be guided using 75Ω coaxial cable from the camera to the transmitter.

6 Warranty

This product is covered by the German statutory warranty. The warranty is fulfilled at the seller's option by repair, replacement or withdrawal of the purchase contract.

The warranty becomes void when the malfunction was or is caused by third party, or by improper installation, or commissioning or modification, by incorrect or negligent handling, or improper transport, or excessive stress, by unsuitable operating resources, by inadequate video transmission systems, by improper use or operation of the product.

Please note that the technical realization of the wireless video transmission from the camera to the end user's video receiver, or video goggle, or head-mounted display has a significant impact on the video quality. Inappropriate video quality caused by the use of unsuitable video transmission systems is therefore not an error or malfunction of the product.

7 Disposal and Environmental Protection

Electrical and Electronic Equipment (EEE) can be recycled when no longer needed and must not be disposed together with usual household waste. Therefore we kindly ask you to support us with your active contribution to the conservation of resources and the protection of the environment by disposing this device at the official EEE collection points.

8 Manufacturer Information and Technical Support

This camera was developed for you by:

TMG - Ingenieurbüro UG (haftungsbeschränkt)	Sales tax ID: DE294861035
Römerstr. 14	WEEE ID: DE55557702
89077 Ulm	Website: www.themissinggear.eu
GERMANY	Contact: info@themissinggear.eu

Please feel free to contact us for technical assistance or other questions about the product.

9 Regulatory Notes

9.1 United States of America

Note: This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Note: Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

9.2 Canada

This Class B digital apparatus complies with Canadian ICES-003.

Cet appareil numérique de la classe B est conforme à la norme NMB-003 du Canada.

9.3 European Union

Declaration of Conformity

We,

TMG - Ingenieurbüro UG (haftungsbeschränkt)

Römerstr. 14

89077 Ulm

GERMANY

declare under our sole responsibility, that the product

Product name	NerdCam3D
Trade name	The Missing Gear
Model	Mk. 2

to which this declaration relates, is in conformity with the following directives and harmonized standards:

EMC Directive 2014/30/EU	EN 55022:2010
	EN 55024:2010
RoHS Directive 2011/65/EU	EN 50581:2012

The technical documentation is kept at the above mentioned address open for inspection.

Ulm, 12. February 2016

Dr.-Ing. Michael Sabielny
Managing Director

Notes